Preliminary Project Execution Plan

Center for Functional Nanomaterials
Brookhaven National Laboratory

Project No. 04-CH-108
January 2003

BROOKHAVEN NATIONAL LABORATORY

BNL Center for Functional Nanomaterials

Basic Energy Sciences

BROOKHAVEN NATIONAL LABORATORY BROOKHAVEN SCIENCE ASSOCIATES

PROJECT EXECUTION PLAN

CENTER FOR FUNCTIONAL NANOMATERIALS

Basic Energy Sciences Program (BES)

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1. INTRODUCTION

The purpose of this document is to identify the plans, organization and systems used to manage the Center for Functional Nanomaterials Project (CFN), and serve as a useful guide in implementing these management methods.

Adherence to the plans described herein will allow all individuals involved with the project to understand their roles and responsibilities required to achieve the project objectives. Furthermore, implementation of the project plan will provide the oversight, feedback and controls required to determine progress toward schedule, quality, cost and performance goals and apply timely corrective action when necessary.

The project will be designed to the latest edition of codes, orders, standards, and guides in accordance with DOE Order 413.3, “Program and Project Management for the Acquisition of Capital Assets.” The project will be executed by an Integrated Project Team (IPT) consisting of DOE, BNL and contractor staff.

2. PROJECT PURPOSE AND JUSTIFICATION

The mission of the DOE Basic Energy Sciences (BES) program – a multipurpose, scientific research effort – is to foster and support fundamental research in focused areas of the natural sciences in order to expand the scientific foundations for new and improved energy technologies and for understanding and mitigating the environmental impacts of energy use. As part of its mission, the BES program plans, constructs, and operates major scientific user facilities to serve researchers at universities, national laboratories, and industrial laboratories.

In fulfilling its mission, the BES program has taken the lead within the Department of Energy (DOE) with the National Nanotechnology Initiative (NNI) to construct regional Nanoscale Science Research Centers (NSRC) strategically located throughout the DOE complex. The Center for Functional Nanomaterials (CFN) at Brookhaven National Laboratory (BNL), the only NSRC proposed for the northeastern United States, is a cornerstone of the NNI and BES program plans. The mission need was approved in June 2002 and the current scope has not changed since that time. The BNL CFN’s scientific theme is *atomic tailoring of functional nanomaterials to achieve a specific response.*

The CFN will serve as the nucleus of an integrated BNL program in nanoscience. It will facilitate major new directions in BNL's materials and chemical research programs, and greatly expand the capabilities available to a national user base, thereby increasing our university and industrial interactions. It will enable us to focus the efforts of organizations within BNL by promoting complementary, interdisciplinary work, including the Chemistry Department, the Materials Science Department, Condensed Matter Physics, the Instrumentation Division, the National Synchrotron Light Source Department, and the Biology Department. The CFN will also integrate BNL's unique capabilities in a broad range of synchrotron techniques, including hard and soft x-ray scattering and spectroscopy, with new materials synthesis and nanofabrication capabilities at BNL. The CFN will serve as a focal point for collaborations, enabling studies of functional materials at the nanoscale involving academia and private industry, particularly in the Northeast, thereby catalyzing a new approach to materials research at BNL.

An overriding need is to provide an organizational infrastructure open to external users based on peer review that will enable and promote a truly national nanomaterials effort, thereby creating breakthrough opportunities. The NSRCs also provide a long-term commitment to the solution of significant research problems and to the development of a new generation of researchers equipped to explore the properties of science and technology at the nanoscale. The CFN at BNL satisfies the criteria in the BES NSET Program for NSRCs.

3. PROJECT DESCRIPTION

The project scope includes the design and construction of a laboratory building and the acquisition of the requisite instrumentation to support the nanoscience thrust areas and laboratory functions that are identified in Section 2, Technical Facilities of the CDR.

The CFN structure will be a two-story building of approximately 85,000 square feet, housing clean rooms, wet and dry laboratories, office space for CFN staff and users, and conference rooms. The building will incorporate human factors into its design so as to encourage peer interactions and collaborative visits between BNL staff and users. In addition to offices and laboratories, it will house "interaction areas" for informal discussions and lunch rooms on each floor to foster scientific discourse. This design approach is commonly regarded as the state-of-the-art in research facility design.

Material and system selections will address the principles of sustainable design to insure low energy and maintenance costs over the life of the building. Design features will be incorporated into the building design that account for the sensitivity of nanoscience instrumentation, i.e., vibration isolation, temperature controls to +/- 1.0 F degrees and shielding from electromagnetic interference.

The CFN will operate through major laboratory clusters: including facilities for nanopatterning fabrication, ultrafast optical sources, electron microscopy, materials synthesis, proximal probes surface characterization, theory and computation, and an endstation at an NSLS beamline optimized for nanoscale characterization using small angle scattering. An initial set of scientific equipment for these laboratories will be purchased as part of the project. The NSLS provides a wide range of imaging, spectroscopy, and diffraction/scattering techniques. In order to take advantage of these features, including the NSLS endstation, the CFN Users will have assured access to a suite of existing beamlines at the NSLS including: soft x-ray microscopy beamlines; UV, soft and hard x-ray spectroscopy beamlines; soft and hard x-ray scattering beamlines; an infrared spectro-microscopy beamline; an undulator insertion device microprobe beamline; and an undulator insertion device nanoprobe beamline.

The BNL Center for Functional Nanomaterials will be a structure integrated with the existing NSLS and Instrumentation facilities to complement the existing functions of these facilities. Siting of the CFN will take advantage of proximity to the Instrumentation Division (Building 535), the Physics (Building 510), Materials Science (Building 480), and NSLS (Building 725) Departments, which are key interdisciplinary participants in nanoscience research.

The CFN will integrate existing BNL capabilities including in its synchrotron characterization techniques, its LEAF electron source, and its growing electron imaging facilities with new materials synthesis, imaging, materials temporal probes, and nanofabrication capabilities. The CFN will draw on the experience and infrastructure of the existing NSLS User Program, which handles more than 2500 users per year, to establish an active CFN User Program, including both individual and cooperative ventures. At full capacity, we estimate that 300-500 users will work at the CFN each year.

4. MANAGEMENT ROLES AND RESPONSIBILITIES

A. DOE Basic Energy Sciences (DOE/BES)

DOE/BES is the sponsoring program for this project and responsible for execution of DOE Office of Science program activities in basic energy sciences. DOE/BES approves and provides funding allocations and project reviews, approvals and authorizations in accordance with DOE project management systems. DOE/BES approves any change in the project TEC and all major changes to the project scope or schedule, as defined in the change control thresholds of this PEP. DOE/BES is also responsible for implementing the ESAAB Equivalent Board process for approval of Critical Decisions as defined in the Authorization section of this PEP. Oversight of the CFN for BES will be performed by the DOE/BES Program Manager.

B. DOE – Brookhaven Area Office (BAO)

The DOE/BAO Federal Project Manager or his designated deputy has the overall responsibility for monitoring adherence to the project's cost, schedule and technical baselines. Changes in the project baselines will require approval by DOE/BAO Federal Project Manager in accordance with the project change control thresholds defined in this PEP. The DOE/BAO Federal Project Manager will maintain cognizance of project scope, cost and schedule status through regular interaction of the IPT, attendance of periodic reviews and review of monthly status reports.

C. BNL Directorate

The Associate Laboratory Director for Basic Energy Sciences (ALD/BES) has overall responsibility for implementation of DOE/BES funded research programs at BNL. The ALD/BES has overall responsibility for the CFN as well as allied BES nanoscience initiatives such as the "jump start" and CFN user outreach programs. The ALD/BES is the primary interface in communication between BNL and DOE/BES and DOE/BAO.

D. CFN Director

The CFN Director has overall responsibility for the CFN project and allied initiatives such as the “jump start”, CFN user outreach programs and future transition to CFN operations. The CFN Director reports directly to the ALD/BES and reviews and approves any changes to CFN scope, cost and schedule objectives.

E. CFN Project Manager (PM)

The CFN Project Manager is directly responsible for implementing management methods required to achieve the CFN project’s specific objectives. The PM is responsible for coordination and execution of all activities required to meet technical, schedule and cost objectives.

This Project will be managed by the PM in the project management organization indicated by **Figure 1**. As such, the PM is the central point of communication between BNL-BES management and the BNL CFN Level Two WBS Managers. The PM is responsible for maintaining project documentation, technical content and adherence to scope, quality, schedule and cost objectives in accordance with DOE Order 413.3, “Program and Project Management for the Acquisition of Capital Assets.” The PM, using BNL’s Standards Based Management System and the management and control systems and authority delineated in the Project Execution Plan, reports to the CFN Director. In this capacity, the PM shall:

1. Provide overall management and coordination of the work of all IPT participants.

2. Review and concur on all contracts and purchase orders.

3. Review and comment on all project documents, including reports, drawings, specifications, schedules and cost estimates.

4. Submit project documents to the CFN Director, DOE/BAO or BNL Management for review, approval and/or comment and maintain records of same.

5. Consolidate/reconcile DOE/BAO and BNL comments.

6. Provide advance notification of all formal project meetings to DOE/BAO personnel, BNL Management and BNL project staff, as appropriate.

7. Conduct formal Project Review Meetings monthly, quarterly, or more frequently, as required.

8. Implement a project Quality Assurance Program.

9. In concert with the ES&H Coordinator, develop a course of action to comply with regulatory requirements and resolve any safety issues to meet project schedule objectives for beneficial occupancy and transition to operations. The PM has overall accountability for project safety.

10. Provide reports to the BNL Directorate for transmittal to DOE/BAO as required.

11. Ensure completion of Environmental Review (NEPA) and preparation of all applications for permits required for regulatory compliance.

F. Technical Construction Coordinators

The Technical Construction Coordinators are directly responsible for scope, cost and schedule performance of technical design, technical procurement, technical liaison, and installation and commissioning of technical equipment. In this capacity, the Technical Construction Coordinators:

1. Reports to the CFN PM.

2. Coordinates the efforts of the individual cluster leaders to assure technical performance objectives are achieved.

3. Provides technical specifications to Technical Procurement Manager and assures cluster leaders act as technical liaison during procurement and contract closeout.

4. Provides technical requirements for conventional facilities to the Conventional Construction Manager.

5. Coordinates and oversees installation, commissioning and testing of technical equipment.

6. Coordinates transition from technical construction to operation.

G. Conventional Construction Manager

The Conventional Construction Manager is directly responsible for scope, cost and schedule performance of conventional facility design and construction. In this capacity, the Conventional Construction Manager:

1. Reports to the CFN PM.

2. Manages the efforts of the A/E firm to perform Title I and Title II design.

3. Administers the technical terms of the construction contracts and contracts with independent testing laboratories. Assures that all contractors and vendors for conventional facilities perform in accordance with the terms of their contracts and purchase orders.

4. Manages the BNL engineering staff review of A/E designs and coordination with BNL utilities, systems and design standards.

5. Manages the Title III construction management, inspection, quality assurance, testing and startup of conventional facilities.

6. Coordinates with the Technical Construction Coordinators to assure technical equipment requirements are incorporated into conventional facility design.

7. Coordinates with ES&H Coordinator to assure that all ES&H regulations, permits and reviews are properly complied with and addressed in the design and construction of conventional facilities.

H. Technical Procurement Manager

The Technical Procurement Manager is responsible for preparation of bidding, award and contractual documents and oversight of all major procurements of

technical equipment. The Technical Procurement Manager will assure that procurements are carried out in accordance with DOE and Federal acquisition regulations (DEAR's/FAR's), and that technical performance requirements included in the contracts are met through implementation of the Quality Assurance Program.

I. Environmental, Safety and Health Coordinator

The Environmental Safety and Health Coordinator is responsible for implementing the BNL ISM program for the CFN project to assure that environmental, safety and health issues are addressed in the design, construction and ultimate operations of the CFN. In this capacity, the ES&H Coordinator will:

1. Oversee preparation of Hazards Analysis and insure the facility design addresses identified hazards wherever feasible.

2. Utilize appropriate BNL ES&H subject matter experts to prepare hazard analyses, review design documents and oversee construction activity to assure compliance with ES&H standards.

3. Oversee performance of beneficial occupancy and occupational readiness evaluations of the CFN as required to enable timely operations in accordance with ES&H requirements.

J. Cost Control Manager

1. Responsible for financial accounting functions and monitoring of all project costs and obligations. Tracks project funding status and establishes project accounts. Prepares and issues financial reports on a monthly basis. Provides input data to earned value performance measurement system.

K. Performance Measurement Administrator

The Performance Measurement Administrator will perform earned value performance analysis and prepare regular reports in accordance with the earned value reporting requirements of DOE Order 413.3. Prepares cost loaded activity based schedule for performance baseline using input from WBS managers. Maintains and updates baseline due to approved BCP's.

L. A/E Design Firm Project Manager

The A/E Design Firm Project Manager will be responsible for preparation of Title I, Title II design reports, drawings and specifications for the CFN and will provide Title III support during facility construction. The A/E Project Manager will report to the BNL Conventional Construction Manager and will prepare all CFN designs in accordance with applicable DOE, Federal and BNL contract requirements.

M. Cluster Leaders

The Cluster Leaders will be responsible for developing the technical performance criteria for their assigned research area, preparing equipment specifications for procurement and design requirements for the supporting conventional facilities needed to achieve the CFN's technical performance objectives. The Cluster Leaders will coordinate and interpret user outreach feedback in concert with DOE program guidance and BNL collaborating departments to develop the program and capability of each cluster. Cluster Leaders will coordinate and oversee procurement, startup and commissioning for operations of instruments in their respective clusters.

N. Conventional Construction Design Manager

The Conventional Construction Design Manager will coordinate the technical design requirements of the Cluster Leaders, ES&H design requirements and BNL's conventional facility design requirements with the A/E firm Project Manager to assure all BNL design requirements are incorporated by the A/E firm.

Figure 1
Center for Functional Nanomaterials
Project Organization

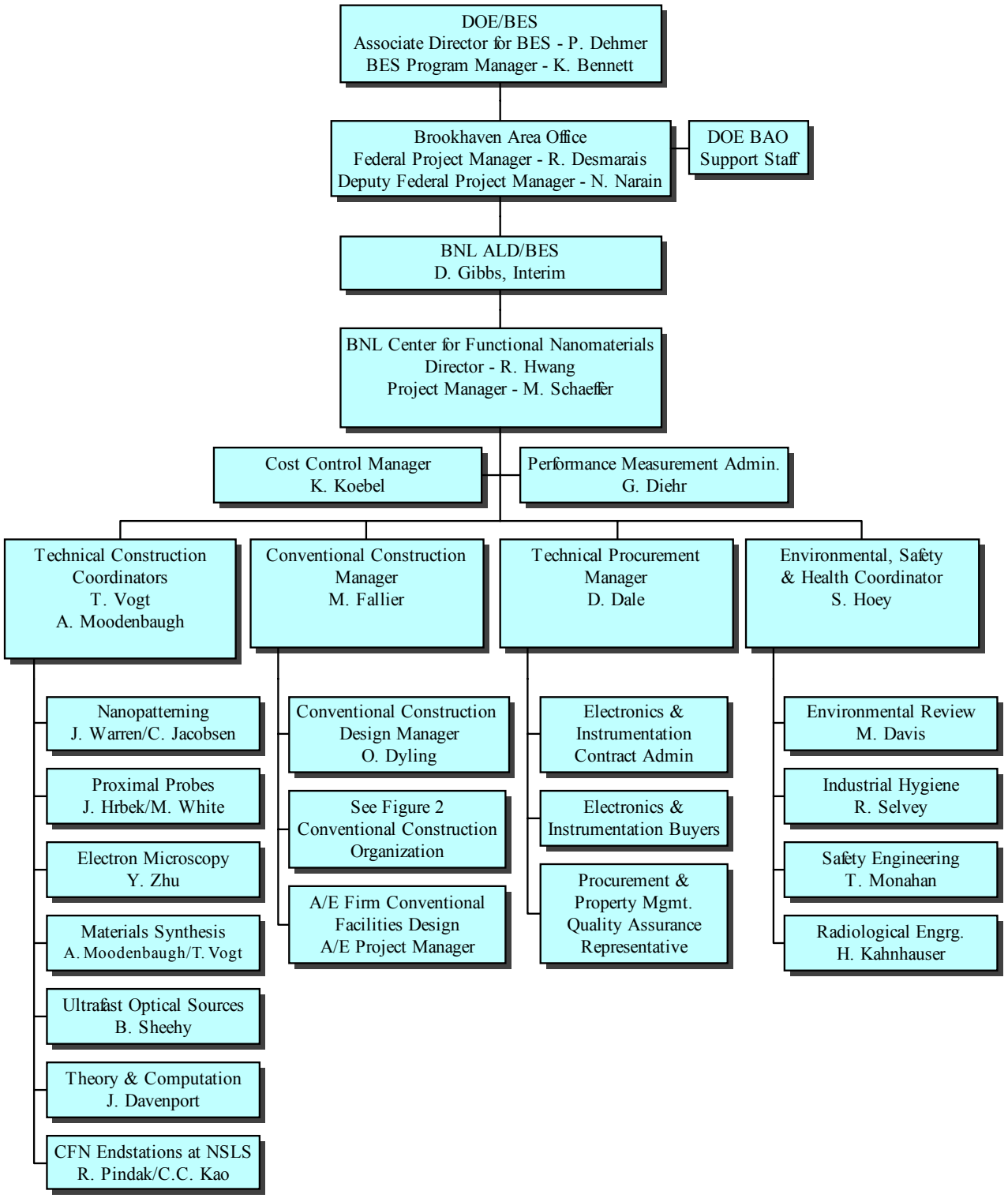


Figure 2
Center for Functional Nanomaterials
Conventional Construction
Project Organization

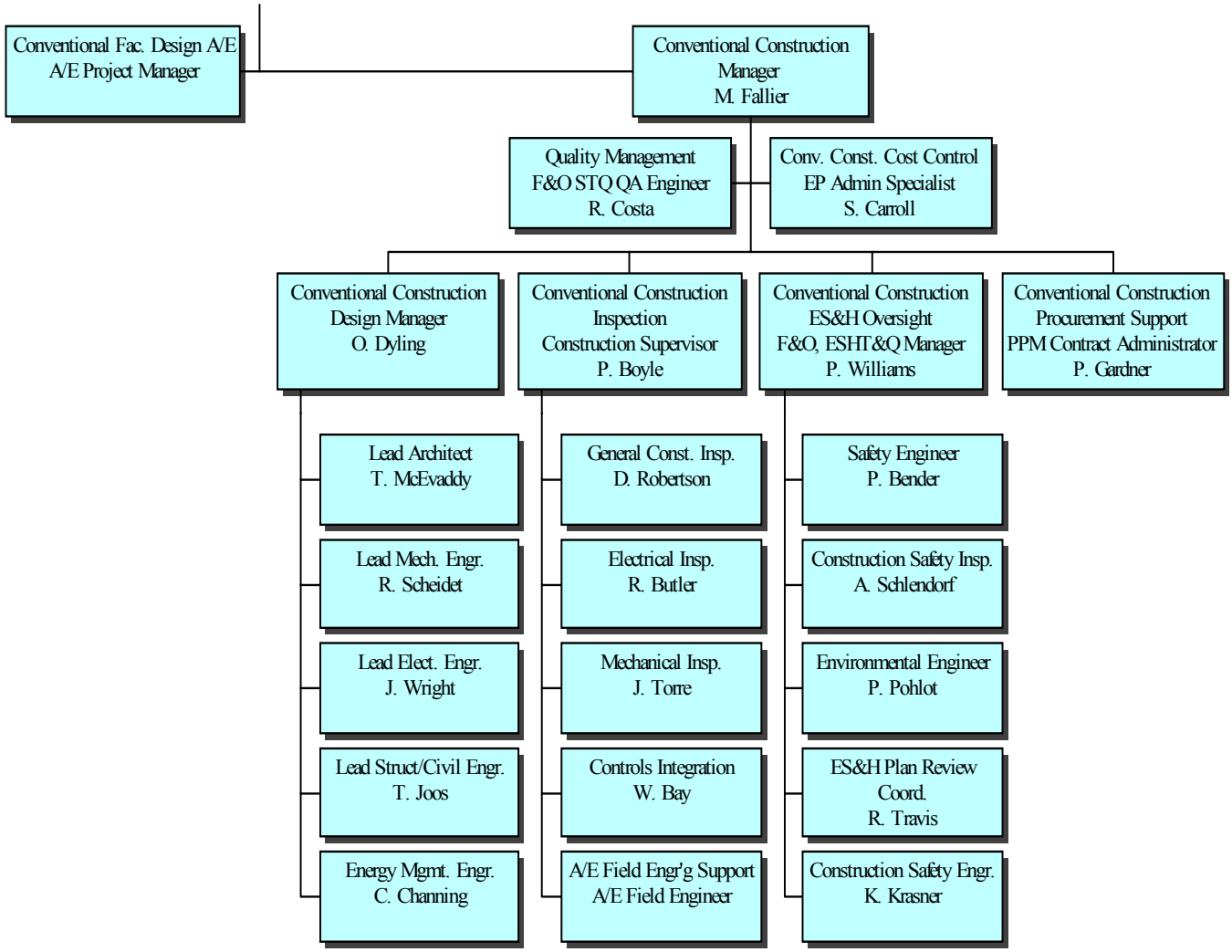
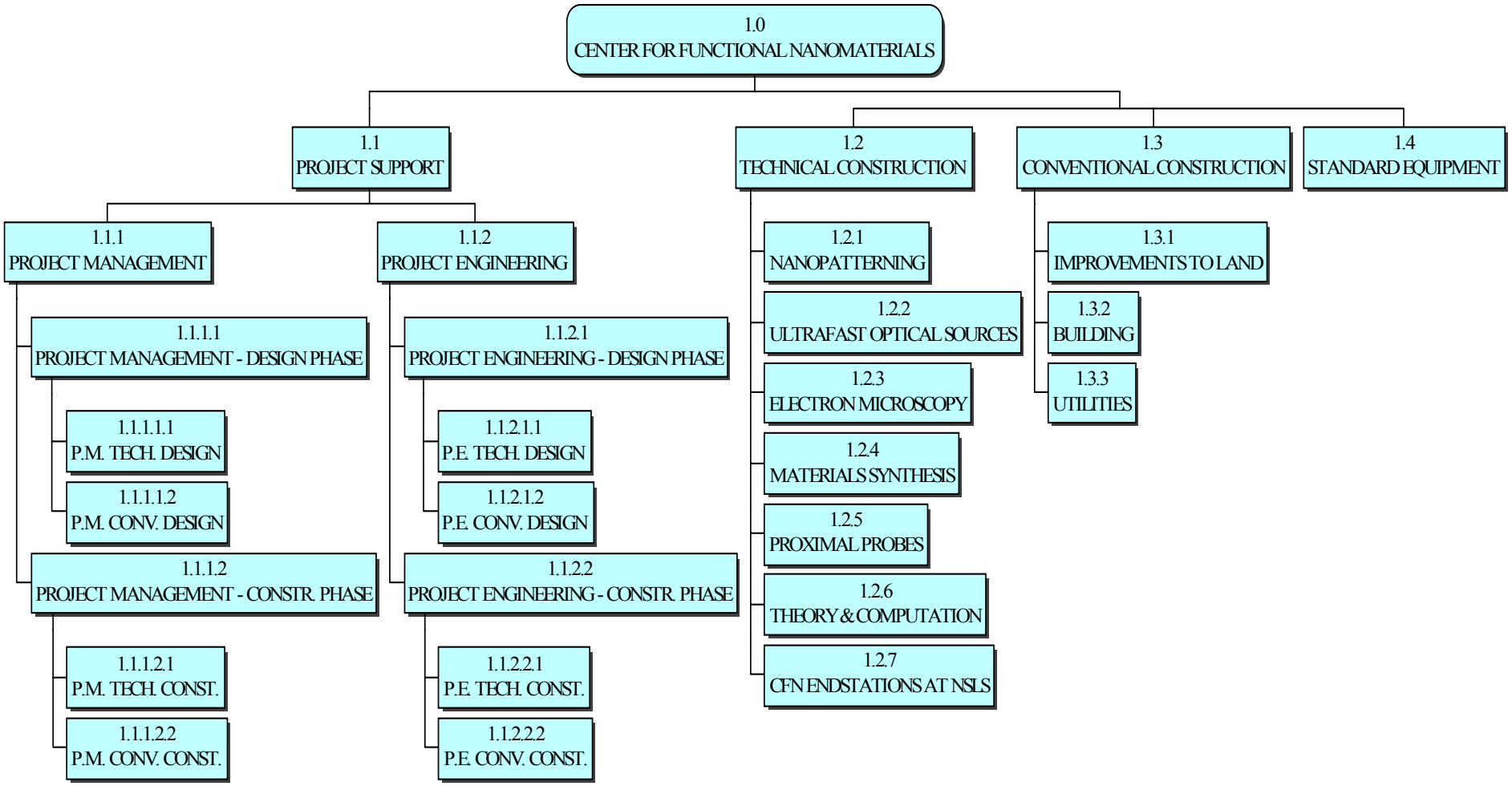


Figure 3
BNL Center For Functional Nanomaterials
Work Breakdown Structure (WBS)



5. ACQUISITION STRATEGY

A. A synopsis of the acquisition strategy is presented here; for full details refer to the project Acquisition Execution Plan.

B. Overall project management and quality assurance will be performed by the BNL CFN Project Office.

C. Title I for the entire project will be performed by an architectural/engineering firm under contract to BNL.

D. BNL will conduct Value Engineering on all Title I design work.

E. Title II design for technical procurement will be by BNL scientific staff.

F. Title II design for construction of the new building will be completed by an architect/engineering firm under contract to BNL.

G. Title III conventional facilities construction will be performed by a lump sum, competitively bid construction contract awarded on the basis of the lowest price firm meeting all BNL qualification criteria. Inspection of Title III will be by BNL construction inspection staff supplemented by A/E field engineering and inspection staff.

H. Title III technical construction will include installation of pre-purchased technical equipment and commissioning and will be peformed by instrument vendor technical staff with support from BNL scientific and technical staff. Some limited fabrication by BNL will also be required.

6. WORK BREAKDOWN STRUCTURE DETAILS

1. As shown in Figure 3, the project WBS 1.0 – BNL Center for Functional Nanomaterials is divided into four main categories: Project Support 1.1, Technical Construction 1.2, Conventional Construction 1.3, and Standard Equipment 1.4. These items are further divided into major WBS elements.

2. WBS 1.1 - Project Support

   a. WBS 1.1.1 – Project Management - includes all work to manage the project in accordance with BNL's Project Execution Plan for DOE Order 413.3. The BNL Project Management Control System (PMCS) describes the procedure for the application of control systems, including control of project contingency. An Earned Value Management System (EVMS) conforming to ANSI standard EIA-748 will be used for performance management throughout the life of the project.

      1) WBS 1.1.1.1 – Project Management - Design Phase includes all work to manage the project during the design phase in accordance with BNL's Project Execution Plan for DOE 413.3. The BNL Project Management Control System (PMCS) describes the procedure for the application of control systems, including control of project contingency.

         a) WBS 1.1.1.1.1 – Project Mgmt Technical Design includes the management effort to support the technical phase of the project.

         b) WBS 1.1.1.1.2 – Project Mgmt Conventional Design includes the management effort to support the construction phase of the project.

      2) WBS 1.1.1.2 – Project Management - Construction Phase includes all work to manage the project during the construction phase in accordance with BNL's Project Execution Plan for DOE 413.3 and includes implementation of the BNL Construction Safety Program.

         a) WBS 1.1.1.2.1 – Project Mgmt Technical Construction includes all the project management effort to support the technical construction phase of the project.

b) WBS 1.1.1.2.2 – Project Mgmt Conventional Construction includes all the project management effort to support the conventional construction phase of the project.

b. WBS 1.1.2 – Project Engineering - includes Title I & II engineering, value engineering and Title III construction inspection services including implementation of the construction safety program.

1) WBS 1.1.2.1 – Project Engineering - Design Phase includes all work to design the project including Title I, Title II & Title III engineering.

a) WBS 1.1.2.1.1 – Project Engineering Technical Design includes all the project design effort to support the technical engineering phase of the project. This includes development of instrument specifications and procurement packages.

b) WBS 1.1.2.1.2 – Project Engineering Conventional Design includes all project design effort to support the conventional engineering phase of the project. This includes Title I and Title II design drawings and specifications, sustainable design, value engineering, and preparation of bid packages.

2) WBS 1.1.2.2 – Project Engineering - Construction Phase includes the engineering effort to support the construction phase of the project.

a) WBS 1.1.2.2.1 – Project Engineering Technical Construction includes all the engineering effort to support the technical construction during the construction phase of the project. This includes instrument procurement inspection, quality assurance, supervision of installation, supervision of start-up and commissioning.

b) WBS 1.1.2.2.2 – Project Engineering Conventional Construction includes the project engineering effort to support the conventional construction activity. This includes shop drawing review, construction inspection, quality assurance, supervision of start-up and commissioning of conventional facilities, utilities and systems.

3. WBS 1.2 – Technical Construction - Consists of competitively bid (where possible), lump sum contracts, as well as in-house fabrication, assembly, installation and testing. The tasks within each WBS element are broken down as follows:

   a. WBS 1.2.1 – Nanopatterning

      New state-of-the-art electron beam, ion beam, and deep ultraviolet patterning; plasma deposition, gas vapor deposition, and vacuum deposition; plasma, wet-chemical etching and appropriate packaging methods to fabricate nanomaterials with nanoscale precision.

   b. WBS 1.2.2 – Ultrafast Optical Sources

      These laboratories will be utilize standard and customized laser sources for the following applications: (1) ultrafast laser probes for examining issues in nanostructures, (2) new sources such as femto-second pulses and X-ray generation from laser-electron beam interactions, and (3) surface non-linear optical probes including second harmonic generation and semi frequency generation.

   c. WBS 1.2.3 – Electron Microscopy

      Planned for acquisition are two transmission electron microscopes including a 200kV instrument with a field emission gun. An ultra-high resolution scanning electron microscope will be available for examination of specimens and quantitative measurements. A sophisticated sample preparation lab will also be installed.

   d. WBS 1.2.4 – Materials Synthesis

      This suite of laboratories is designed to provide a range of thin film, bulk, and soft material synthesis capabilities. Preparation equipment included in these laboratories are a molecular beam epitaxy system, a pulsed laser deposition system, an electron beam evaporator, an arc furnace, and an induction furnace for crystal growth. Analytical and characterization facilities constitute a major portion of the investment. Equipment includes x-ray diffraction equipment, a magnetometer, and thermal properties measurement equipment.

e. WBS 1.2.5 – Proximal Probes

Three laboratories are to be equipped for (1) a general user laboratory for optical characterization of samples using IR, UV and Raman spectroscopy and confocal microscopy, and near-field scanning optical microscopy (NSOM); (2) a development laboratory for spectroscopic near-field microscopy using IR and UV Raman techniques as well as a low energy electron microscope ; (3) a general purpose chemistry laboratory for sample preparation.

f. WBS 1.2.6 – Theory & Computation

This laboratory cluster provides state-of-the-art software and computational equipment, i.e., a Linux cluster computer, with approximately 200 processors,

g. WBS 1.2.7 – CFN Endstations at NSLS

A small angle x-ray scattering end station will be constructed by the BNL CFN. The major components of the end station are an area detector, position sensitive detector, scattering system, optics and microscopes.

4. WBS 1.3 – Conventional Construction - Consists of competitively bid, lump sum contracts. The tasks within each WBS element are broken down as follows:

   a. WBS 1.3.1 – Improvements to Land includes a new parking area to the northeast, reconfiguration of curbing and paving layout and vehicle access to the facility.

   b. WBS 1.3.2 – Buildings includes the foundation, structure, clean rooms, laboratories, offices, lounge areas and conference areas toilet rooms, mechanical spaces, and other support spaces.

   c. WBS 1.3.3 – Utilities includes bringing water, steam, sanitary, communication, data, chilled water, compressed air and electrical services to the building.

5. WBS 1.4 – Standard Equipment includes office furniture, personal computers, blinds and equipment that are off the shelf or only require nominal engineering.

7. PROJECT BASELINES

A. Baseline Establishment

The initial technical, cost, and schedule baselines for the CFN Project are formally established by approval of this Project Execution Plan and provide the basis from which all proposed future changes are measured.

B. Technical Baseline

Create laboratories capable of performing leading-edge research in functional nanomaterials utilizing state-of-the-art instrumentation and capable of supporting collaborative user research teams in the following areas: Nanopatterning; Ultrafast Optical Sources; Electron Microscopy; Materials Synthesis; Proximal Probes, Theory and Computation; and CFN Endstations at NSLS.

C. Cost Baseline

The project cost estimate in at-year dollars, including escalation and burden, is $85 million with obligations of $4.1 million in FY 2004, $22.9 million in FY 2005, $42.8 million in FY 2006, and $15.2 million in FY 2007.

WBS 1.0	BNL Center for Functional Nanomaterials		
WBS 1.1	Project Support		$ 8,287,000
	Project Management - Design	$ 1,008,000	
	Project Management - Construction	1,818,000	
	Project Engineering - Design	3,852,000	
	Project Engineering - Construction	1,609,000	
WBS 1.2	Technical Construction		$ 33,447,000
	Nanopatterning	$ 7,791,000	
	Ultrafast Optical Sources	3,666,000	
	Electron Microscopy	9,461,000	
	Materials Synthesis	4,428,000	
	Proximal Probes	6,288,000	
	Theory and Computation	627,000	
	CFN Endstations at NSLS	1,186,000	
WBS 1.3	Conventional Construction		$ 27,337,000
	Improvements to land	$ 889,000	
	Building	22,789,000	
	Utilities	3,659,000	
WBS 1.4	Standard Equipment		$ 1,317,000
	Contingency		$ 14,612,000
	Project Cost Summary		$85,000,000*

*(Escalated, At-Year Dollars, Rounded to Nearest $1,000
Includes BNL's indirect costs of $ 6,208,000)

D. Schedule Baseline

NEPA Approval	03/26/02 (A)
CD-0 Approval	06/12/02 (A)
Approve CD-1 Preliminary Baseline	03/31/03
Technical Construction	
Technical Design Start	08/02/04*
Approve CD-3 Start of Procurement	12/31/04*
Procurement Start	01/03/05
Technical Design Complete	05/31/06*
Procurement Complete	12/29/06
Installation and Testing Start	01/02/07*
Installation and Testing Complete	11/30/07*
CD-4B – Approval	12/31/07*
Conventional Construction	
Start Title I – Preliminary Design	01/02/04*
Complete Title I – Preliminary Design	03/31/04
Title I - Approval	04/30/04
Approve CD-2 Performance Baseline	05/28/04*
Start Title II – Detail Design	06/01/04
Complete Title II – Detail Design	10/29/04*
Title II – Approval	11/30/04
Approve CD-3 Start of Construction	12/31/04*
Award Contract	02/28/05
Issue Notice to Proceed	04/01/05
Start Construction	05/02/05*
Complete ORE for Occupancy	11/30/06
Complete Construction	12/29/06*
CD-4A – Approval	01/31/07*

*Major Milestone
(A) Actual

8. AUTHORIZATION

Project authorization will conform to the requirements of DOE Order 413.3 as outlined below:

Critical Decision	Approval Authority
CD-0	SC-1/ESAAB
CD-1	SC-1/ESAAB
CD-2	SC-1/ESAAB
CD-3	SC-1/ESAAB
CD-4A/B	BES/ESAAB

SC-1 – Director, Office of Science
BES – Associate Director, Office of Basic Energy Sciences
ESAAB – Energy Systems Acquisition Advisory Board

9. PROJECT MANAGEMENT AND CHANGE CONTROL

A. Measurement

1. Scope, Cost and Schedule Performance Measurement

a. The project scope, schedule and cost baselines identified and described herein shall constitute the project baseline (once approved). This baseline shall only be changed by approved Baseline Change Proposals (BCP) or upon approval of Critical Decision Two (CD-2) at completion of the Title I design.

b. Technical variations to the project scope that significantly alter the intended performance or deliverables will require a BCP. Technical parameters and deliverables shall be monitored through the design, construction and commissioning phases of the project.

c. Measurement of project performance shall utilize an earned value management system (EVMS) conforming to ANSI Std. E1A-748. The system shall be utilized to:

- Establish a baseline cost loaded activity based schedule for the entire project (BCWS) organized by WBS activity.
- Identify in monthly reports the budgeted cost of work performed (BCWP).
- Identify in monthly reports the actual cost of work performed (ACWP).
- Identify the schedule variance (BCWP – BCWS).
- Identify the cost variance (BCWP – ACWP).
- Provide additional analysis indicating estimate at completion (EAC), estimate to complete (ETC) and variance at completion (VAC).
- Provide cost and schedule performance data in terms of $ value and time as well as percent.

d. Performance data shall be compared to the performance thresholds of **Table 1** to determine if variance reporting and corrective action plans are required.

B. Planning & Control

1. Planning

a. To assure proper planning, the CFN Project Manager shall maintain cognizance of technical, schedule, and cost aspects of the facility throughout the design, procurement and construction phases.

b. The CFN Project Manager, at regular intervals, shall review the actual, versus the planned. Reporting will be conducted monthly.

2. Baseline Change Control

Technical scope, schedule, and cost changes will follow the Baseline Change Control Process as outlined in DOE Order 413.3. The change control process will be governed by the thresholds listed below on **Table 2**. Any WBS Level 3 activity exceeding these thresholds will require variance analysis indicating the cause of variance, potential impact to the project and corrective action to be taken.

3. Contingency Management

Notify DOE/BAO in quarterly report if contingency use exceeds 25% of annual contingency prorated over each quarter.

Table 1
Variance Thresholds

Parameter	Project WBS Level 2		Project WBS Level 3		Action
	$ Variance	% Variance	$ Variance	% Variance	
Cost (BCWP - ACWP)	– 250K	– 2%	– 50K	– 5%	Variance Analysis & CA Plan
Schedule (BCWP – BCWS)	– 500K	– 5%	–100K	–10%	Variance Analysis & CA Plan

Table 2

Change Control Thresholds and Authority

	Level 1	Level 2	Level 3
Scope	Change in overall project scope	Change to scope at WBS Level 2	Change to scope at WBS Level 3
Cost	Change in TEC	Cost increase of 20% at WBS Level 2	Cost Increase of 20% at WBS Level 3
Schedule	Delay of completion greater than 2 months	Delay of WBS Level 2 milestone greater than 2 months	Delay of WBS Level 3 milestone greater than 2 months

Approval Authority:

Level 1 – BES Program Manager at DOE Headquarters

Level 2 – DOE CFN Federal Project Manager at Brookhaven Area Office

Level 3 – BNL CFN Project Director

10. REPORTING

The CFN Project Manager is responsible for preparation of all data for reports and reviews in accordance with the appropriate project requirements as follows:

BNL to BAO

- Monthly Project Status Report
- Quarterly Project Status Report / Formal Review
  - Technical Status Narrative
  - Problems / Corrective Actions
  - Schedule Status (Baseline vs. Actual)
  - Cost Status
- Earned Value Report

BAO to DOE/HQ

- PARS
- Quarterly Report
  - Summary Assessment
  - Critical Decision Status
  - Cost & Contingency Status
  - Schedule Summary
  - Narrative Highlights

11. QUALITY MANAGEMENT & VALUE ENGINEERING

A. Total Quality Management

BNL's Total Quality Management System is designed to assure that all aspects of BNL projects are controlled from project inception through project completion. The major objectives of the Total Quality Management System are:

- to meet customer design requirements and exceed customer expectations
- to base design upon established engineering and scientific principles
- to validate designs prior to construction in order to minimize field modifications
- to verify product quality prior to delivery
- to select contractors qualified to support project objectives
- to prevent deficiencies and to efficiently correct non-conformance
- to maintain costs within the budgeted constraints for the project
- to safely and efficiently execute project construction
- to complete the project, as scheduled, to support programmatic objectives

The specific policies and procedures of BNL's Total Quality Management System are documented in the SBMS and the implementing policies and procedures of each department. These policies and procedures are supplemented by the BNL Quality Assurance Manual, and by reference to industry accepted quality standards such as ANSI, ASTM, IEEE, NEMA, and others as appropriate.

B. Value Engineering

Value Engineering is an analysis of the project by functions. The study of functions helps to achieve "best value" for resources involved by improving the relationship of worth or utility to monetary cost. Best value is when an item has the ability to perform its function at an optimum level of quality, reliability, maintainability, and life cycle cost. This analysis reduces processes, equipment, facilities, services, supplies, or products to their most basic functional elements and then looks for cost efficient alternatives.

A formal value engineering review of the project will be performed during the Title I engineering phase to insure that the project technical and quality objectives are met using the most cost-effective approach. A formalized VE program will be followed using an in-house (supplemented by select A/E staff) VE team consisting of trained VE professionals. The Value Engineering methodology to be followed is as outlined in DOE Order 430.1A, "Life Cycle Asset Management."

12. INTEGRATED SAFETY MANAGEMENT

This project will be performed in accordance with BNL's approved Integrated Safety Management (ISM) Program. These requirements are delineated in the BNL Standards Based Management System (SBMS) and further detailed in the implementing policies and procedures of each BNL department or division. These policies and procedures require the following steps consistent with ISM principles:

1. Review of project scope by subject matter experts (SMEs) for identification of hazards prior to design commencement to assure that engineering controls can be incorporated to mitigate hazards wherever feasible.

2. Review of completed design by SMEs to verify that hazards have been addressed and mitigated wherever feasible in the facility or experiments' design and to assure appropriate safety requirements are included in design documents.

3. Selection of contractors or vendors based on their record of acceptable safety performance in addition to cost, commercial and technical qualifications.

4. Application of work controls requirements that assure contractors, vendors and in-house staff are not allowed to proceed with physical work until required safety documents (Safety Plan) are approved, all necessary training is completed and all applicable permits are in place.

5. Regular monitoring and inspection of project execution to assure all hazard mitigation requirements are properly carried out, and that communication processes exist as needed to review and approve any changes in work controls in response to changed conditions.

6. Evaluation of project execution for feedback and continuous improvement of the safety and work controls program.

7. Evaluation of contractor and vendor safety performance at project 50% and 100% completion points to provide feedback for improvement of the contractor's safety program and verify continued qualification to perform work at BNL.

13. RISK MANAGEMENT

Risks anticipated for this project will be managed using a tailored approach in accordance with the methodology identified in the DOE Order for Program and Project Management for the Acquisition of Capital Assets, O 413.3 and is further detailed in the CFN Risk Management Plan. The CFN Project Manager is responsible for applying this risk management methodology during the conceptual design, preliminary design and detailed design phases of the project as well as incorporating risk based decision processes during the construction phase.

14. SYSTEM ENGINEERING AND RELIABILITY

This project will be designed to meet the requirements for Sustainable Design in DOE Order 413.3 and the LCAM Order. The project design team will include architectural and engineering staff trained in sustainable design, familiar with Leadership in Energy and Environmental Design (LEED) rating criteria, and recommendations of the Green Building Council. The project team will also include an environmental engineer responsible for identifying pollution prevention opportunities and a certified energy manager / energy engineer responsible for identifying energy savings opportunities and performing an energy analysis. The project design objective will be to achieve the highest LEED rating possible consistent with mission functional requirements and the established project budget.